OCCASIONAL PAPER NO. 97 NOVEMBER 8, 1940

SOUTHERN FOREST EXPERIMENT STATION

E. L. Demmon, Director

New Orleans, La.

INCREASED NAVAL STORES PRODUCTION FROM CHEMICALLY TREATED STREAKS

By

T. A. Liefeld
Associate Silviculturist
Southern Forest Experiment Station

The Occasional Papers of the Southern Forest Experiment Station present information on current southern forestry problems under investigation at the station. In some cases, these contributions were first presented as addresses to a limited group of people, and as "occasional papers" they can reach a much wider audience. In other cases, they are summaries of investigations prepared especially to give a report of the progress made in a particular field of research. In any case, the statements herein contained should be considered subject to correction or modification as further data are obtained.

Note: Assistance in the preparation of these materials was furnished by the personnel of Work Projects Administration official project 65-2-64-74.

INCREASED NAVAL STORES PRODUCTION FROM CHEMICALLY TREATED STREAKS

By T. A. Liefeld, Associate Silviculturist
Southern Forest Experiment Station

Application of a chemical reagent to the freshly chipped streak is one of the most promising recent developments for increasing gum naval stores yields. Present market conditions do not favor expanded production, but producers should welcome the opportunity offered by this new technique to cut production costs. Some operators may thereby find aid in solving problems caused by continued low market quotations for turpentine and rosin. Apparently originating in Germany about 1933, the idea of chemical stimulation has received increasing attention there and in Russia.[1/] A large number of chemicals has been tested. Yield increases of 100 to as much as 250 percent have been reported, but most of the reports are conflicting. There is general agreement, however, that double streaks, i.e., streaks approximately twice as high as normal, must be removed at each chipping in order that increased yields may be maintained, particularly if strong acid solutions are used.

Because of the apparent possibilities for chemical treatment in this country, the Southern Forest Experiment Station, in cooperation with the Bureau of Agricultural Chemistry and Engineering (formerly Bureau of Chemistry and Soils), conducted a small exploratory test on the Olustee Experimental Forest in 1936 to determine the advisability of more thorough study. The conclusions drawn were that (1) yield can be stimulated by applying chemical reagents to the streak, (2) with some chemicals, or at least with certain concentrations, it may be necessary to remove more wood than is required for untreated streaks, and (3) further study was justified. Accordingly, a more intensive study was conducted during 1938.

Materials and Methods

To keep the experiment within the limits of available manpower, it was necessary to select as carefully as possible the reagents most likely to show promise. On advice of chemists and plant physiologists sulphuric acid, acetic acid, and washing soda were chosen in order to have represented an active inorganic acid, an active organic acid, and an active alkali. A relatively weak (5%) and a relatively strong (20%) solution of each reagent in distilled water were selected. In order to determine, within the limits of practical application, how much wood must be removed to maintain prospective increased yields, a range of streak heights was applied.

A total of 168 second-growth pines—84 longleaf and 84 slash—were selected early in April 1938. Galvanized cups and tins were installed and 4 streaks were chipped, 1/2 inch high and 1/2 inch deep, at weekly intervals

---

1/ Kublun, H. Turpentining pines with chemical reagents. 64 pp., illus. J. Neumann, Neudamm. 1936. (In German.)
Nikolaev, N. F. and M. A. Sinelobov. The influence of chemicals on gum yields. Forest Chemical Industry 6: 4-9. (In Russian.)

during that month. Total gum yield was weighed on a balance scale to the nearest gram for each tree and streak. With these yields as a basis, the trees were divided into equal-yielding groups of 4 trees each. Treatments were begun with the fifth streak on May 4 and continued without interruption for 30 consecutive weekly chippings until November 23. Individual tree yields were obtained for each streak throughout the duration of the study. Maximum air temperatures on the days of chipping were recorded so that allowance could be made for the effect of temperature on gum yield. The tests included all possible combinations of (1) species (longleaf and slash pine), (2) height of streak (1/4 inch, 5/8 inch, 1 inch), and (3) chemical reagents (5 and 20 percent solutions of sulphuric acid, acetic acid, and washing soda; and no reagent, or check). Depth of streak was uniformly 1/2 inch, regardless of treatment.

Effect of Chemical Treatments on Gum Yield

The average yield per streak produced by each of the 4-tree groups during the 30-streak period of treatment is presented in table 1. From the standpoint of practical application, the most significant comparisons within the table are: (1) Slash pine chipped 5/8 inch high produced 67 percent more gum with the aid of 20% sulphuric acid than without it, and (2) longleaf pine chipped 1 inch high produced 27 percent more when similarly treated. The 5% sulphuric acid solution was not effective except on 1-inch streaks, but with this height of streak the 20% solution proved almost twice as beneficial. Both concentrations of acetic acid proved, with almost no exceptions, to be practically worthless as stimulants. Almost all of the washing soda treatments increased yields, but the gains were hardly sufficient to offset the cost of application.

Commercial Possibilities of 20% Sulphuric Acid Treatment

Because 20% sulphuric acid was the only reagent tested that was found to have commercial possibilities, a more detailed analysis of this treatment was made to bring out in greater detail the effect of streak height in combination with the acid. Results of this analysis are presented in figure 1, which shows for both longleaf and slash pine the net trends of the yields during the course of the experiment for the three heights of streak employed. Effect of temperature was largely accounted for and removed by the multiple regression method of analysis.

It is evident from the chart that height of streak is an important consideration in connection with acid application, at least with stronger acid solutions such as 20% sulphuric acid. A streak height of 1/4 inch is not adequate to maintain increased yields beyond relatively few chippings: the yields of the slash pine group rose considerably immediately after acid treatment was begun (at streak number 5) but began to decline after about 10 streaks had been treated (at about streak number 15). From then on until the end of the year the acid-treated group actually produced somewhat lower yields than the no-acid group. As a result there was no significant difference between the average yields of the acid and no-acid treatment for the entire 30-streak treatment period. For the longleaf pine groups, chipped 1/4 inch high, on the other hand, there was actually a significant difference in

Table 1.—Effect of chemical treatments on gum yield

Height of streak and reagent	Slash pine			Longleaf pine		
	Average yield per streak 1/	Comparison with check-tree yields		Average yield per streak 1/	Comparison with check-tree yields	
		Increase	Decrease		Increase	Decrease
	Grams	Percent	Percent	Grams	Percent	Percent
1/4 inch:						
No treatment	428	..	..	306	..	..
5% sulphuric acid	353	..	18	262	..	14
20% sulphuric acid	462	8	..	207	..	32
5% acetic acid	364	..	15	248	..	19
20% acetic acid	440	3	..	220	..	28
5% washing soda	369	..	14	326	6	..
20% washing soda	407	..	5	318	4	..
5/8 inch:						
No treatment	431	..	..	344	..	..
5% sulphuric acid	403	..	6	298	..	13
20% sulphuric acid	720	67	..	328	..	5
5% acetic acid	372	..	14	290	..	16
20% acetic acid	438	2	..	282	..	18
5% washing soda	486	13	..	374	9	..
20% washing soda	435	1	..	353	3	..
1 inch:						
No treatment	422	..	..	357	..	..
5% sulphuric acid	528	25	..	393	10	..
20% sulphuric acid	591	40	..	455	27	..
5% acetic acid	486	15	..	276	..	23
20% acetic acid	417	..	1	327	..	8
5% washing soda	472	12	..	428	20	..
20% washing soda	481	14	..	421	18	..

1/ Averages for test groups of 4 trees during 30-streak treatment period.

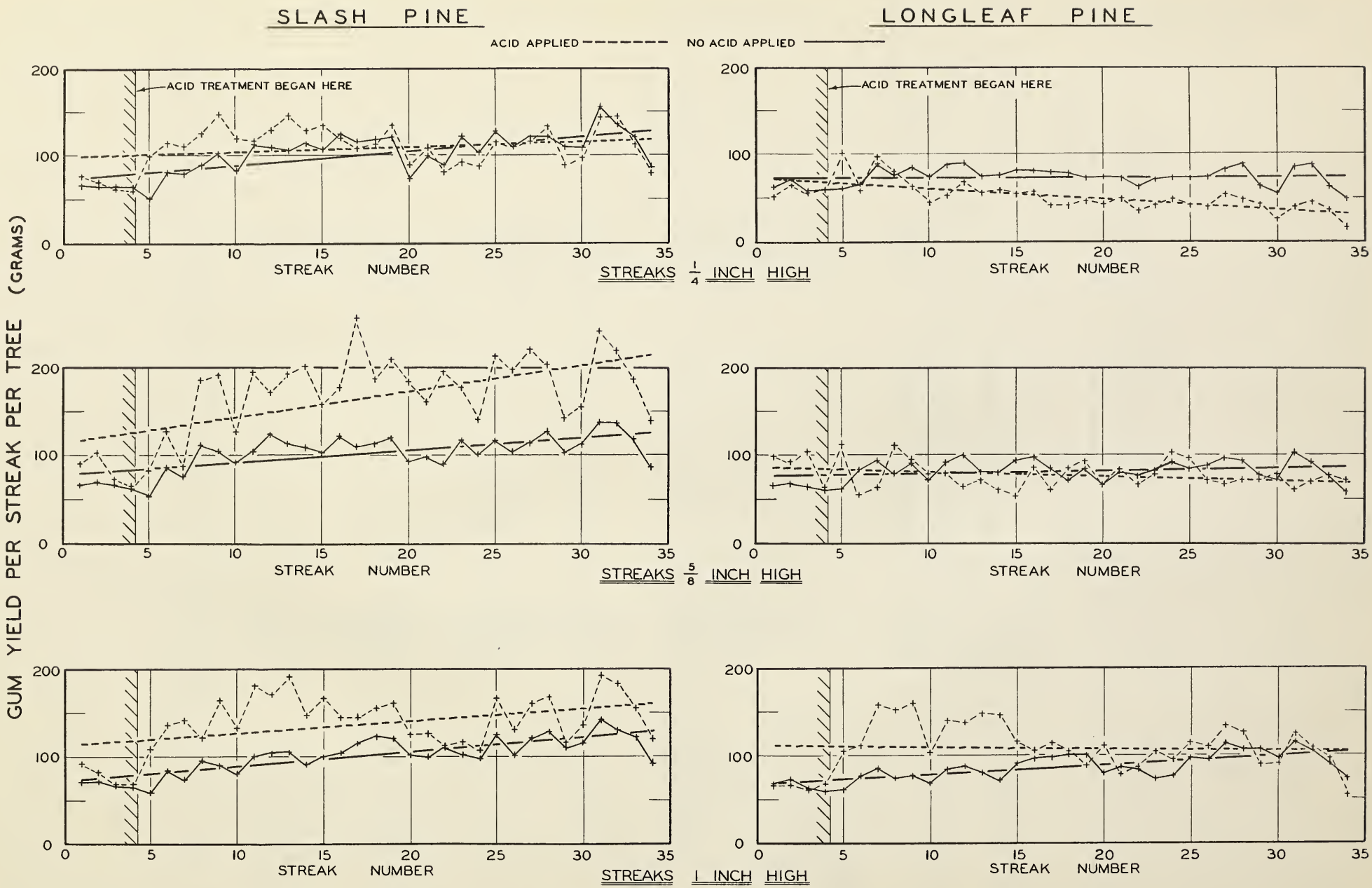

FIGURE 1.— NET TRENDS OF GUM YIELD (EFFECT OF TEMPERATURE PARTIALLY REMOVED) BY SPECIES, STREAK HEIGHT, AND REAGENT TREATMENT.

favor of the no-acid treatment. With streaks 5/8 inch high the acid-treated slash pine produced and maintained significantly higher yields than the no-acid group, whereas there was no difference between the two longleaf pine groups. With a 1-inch height of streak slash pine still responded favorably to acid application, but the yields from the acid treatment again began to decline during the latter half of the period, indicating that this height of chipping removed more wood than necessary for sustained optimum yields. For longleaf pine, however, the 1-inch streak height proved more desirable than either 1/4- or 5/8-inch in that it produced a significant difference in favor of acid treatment. The charts for longleaf pine indicate, moreover, that even 1-inch streaks were not sufficient to maintain increased yields for the duration of the season and that greater yield differences might have been obtained from the acid treatment if more than 1 inch of wood had been removed at each streaking. But it is doubtful that acid application would be of value in commercial practice if more than a double streak must be chipped. The labor of triple streaking would be at least double that of chipping a single streak. From the data on longleaf pine at hand, it seems highly improbable that triple streaking with acid treatment would result in increasing the yield to twice that obtained from a single untreated streak.

One of the most important points brought out by the study is that longleaf and slash pine do not react alike to chemical reagents. The yield from slash pine was increased when 20% sulphuric acid, the most effective reagent, was applied to streaks chipped either 1/4, 5/8, or 1 inch high. Longleaf pine streaks, however, chipped 1/4 and 5/8 inch high and similarly treated, produced less gum than untreated streaks. Only when chipping was 1 inch high was it possible to increase yields from this species. Until further chemicals are tested, therefore, it appears that chemical stimulation holds greater promise for slash pine. These preliminary investigations indicate that yield increases up to 67 percent can be expected from stands composed predominantly of this species when streaks are chipped approximately 1/2 inch high and a 20% sulphuric acid solution is applied to the streak immediately after chipping. In longleaf pine stands, on the other hand, it will be necessary to chip streaks 1 inch high in order to obtain increases of yields up to only 27 percent.

The chemical solution is made by pouring one pint of concentrated (95%) commercial grade sulphuric acid, obtainable at most drug stores for about 20 cents a pint, into a gallon of distilled or rain water.[2/] The acid should be poured into the water (never the water into the acid) and mixed thoroughly by stirring in an earthenware or glass vessel. The solution should not be stored in a metal container; it will corrode the metal in time. Care should be exercised in handling the solution, for it may injure the eyes or clothing. It is not injurious to the hands. A chipper can carry a bottle of the solution in his hip pocket and daub it on the fresh streak with a dauber made by wrapping a small soft cloth around a stick.

In a series of laboratory tests the Bureau of Agricultural Chemistry and Engineering has been unable to discover any chemical or physical changes in the gum or its products, turpentine and rosin, caused by the application of chemical reagents to the streak. Moreover, galvanized cups and tins are

---

2/ Chemical concentrations are commonly based on weight rather than on volume. The procedure described results in a solution (by weight) of approximately 20%.

not seriously affected by the 20% sulphuric acid solution, probably because of a combination of the following circumstances: (1) Only a small amount of solution is required for each streak, (2) rain water, which is present in cups much of the time, dilutes the solution considerably, and (3) the solution is quickly absorbed by the wood of the fresh streak.

Summary

Chemical reagents applied to the fresh streak offer considerable promise of increasing gum naval stores yields. The experiment described in this paper tested six reagents (5 and 20% solutions of sulphuric acid, acetic acid, and washing soda) applied to 1/4-, 5/8-, and 1-inch streaks on slash and longleaf pine. The 20% sulphuric acid treatment applied to streaks 5/8 inch high increased yields from slash pine 67 percent, whereas on longleaf pine it was necessary to chip streaks 1 inch high in order to maintain yields 27 percent greater.

These preliminary investigations indicate that gum production from stands which are predominantly slash pine can be stimulated by daubing 20% sulphuric acid on the fresh streak chipped approximately 1/2 inch high. Unless the operator has only the largest immediate return to consider, because he is planning to cut the trees after several seasons of turpentining, the acid treatment does not appear profitable for use in longleaf pine stands.